9. AC Power Line Conducted Limits

221. In the *Notice*, the Commission proposed to retain the existing limit in 47 CFR Section 15.207 for controlling the amount of energy permitted to be conducted onto the AC power lines as a reasonable starting point for establishing standards until additional experience can be gained with this equipment.[333] None of the comments objected to retaining the existing Part 15 limits on RF energy conducted onto the AC power lines.[334] We concur and are adopting a limit of 250 uV over the frequency range of 450 kHz to 30 MHz, as proposed in the *Notice*.

10. Summary of Emission Limits Being Adopted in this Report and Order

222. As stated in the *Notice*, the establishment of emission limits requires a firm understanding of the characteristics of UWB signals, their impact on victim receivers, and the minimum separation distance between UWB devices and victim receivers: almost any transmitter will cause interference if it is too close to a receiver.[335] We have attempted to apply the data submitted in the various comments, tests and analyses to determine what emission limits are acceptable for UWB operation. Our task was to determine limits based on reasonable, real-world applications and not just on the results of laboratory measurements conducted in anechoic chambers. While such measurements are necessary to determine if further investigations are necessary or additional caution should be applied, they demonstrate the possible performance capabilities of products in the absence of other RF noise sources. In some cases, we have adjusted the levels determined from the various analyses to reflect our desire and the desire of NTIA to proceed cautiously.[336]

223. The limits we are adopting in this proceeding are considerably lower in some frequency ranges than the current Part 15 levels. While these limits may prove to be lower than what is necessary, we believe that such caution is needed in the early stages of UWB implementation. Once additional experience is gained with this equipment and a better understanding develops regarding operating frequency and allowable emissions levels, we may be able to revisit these limits. In the interim, the following summarizes the emission limits being adopted in this Report and Order.

224. Based on the proceeding discussion, we are adopting the following emission limits for UWB devices:

- Coordinated GPRs, wall imaging and through-wall imaging systems may operate with the –10 dB bandwidth below 960 MHz at the Part 15 general emission limits provided emissions in the 960-1610 MHz band are attenuated below the general limits by 24 dB; narrowband emissions in the GPS bands are attenuated below the general limits by 34 dB; emissions in the 1610-1990 MHz are attenuated below the general limits by 12 dB; and emissions above 1990 MHz are attenuated below the general limits by 10 dB. There are usage restrictions and a labelling requirement.

- Coordinated through-wall imaging systems and surveillance systems may operate with the –

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333 The Commission proposed to modify the AC power line conducted emission limits in 47 C.F.R. § 15.207. *See Notice of Proposed Rule Making* in ET Docket No. 98-80, 64 Fed. Reg. 62159, November 16, 1999, http://www.fcc.gov/Bureaus/Engineering_Technology/Notices/1999/fcc99296.wp.

334 *See*, for example, the comments of ARRL at pg. 16, A. Peter Annan at pg. 7, and TDC at pg. 34. While Mr. Annan's comments address conducted limits applicable to digital devices, UWB devices are intentional radiators though they also may contain digital circuitry.

335 *Notice*, *supra*, at para. 32.

336 *See* letter of February 13, 2002, from William Hatch, supra.

10 dB bandwidth within the band 1990 MHz to 10,600 MHz at the Part 15 general emission limits provided emissions below 960 MHz do not exceed the general limits; emissions in the 960-1610 MHz band are attenuated below the general limits by 12 dB; narrowband emissions in the GPS bands are attenuated below the general limits by 22 dB; emissions in the 1610-1990 MHz band are attenuated below the general limits by 10 dB; and emissions above 10,600 MHz are attenuated below the general limits by 10 dB. There are usage restrictions and a labelling requirement.

- Coordinated GPRs, wall imaging and medical imaging systems may operate with the –10 dB bandwidth within the band 3100 MHz to 10,600 MHz at the Part 15 general emission limits provided emissions below 960 MHz do not exceed the general limits; emissions in the 960-1610 MHz band are attenuated below the general limits by 24 dB; narrowband emissions in the GPS bands are attenuated below the general limits by 34 dB; emissions in the 1610-1990 MHz band are attenuated below the general limits by 12 dB; emissions in the 1990-3100 MHz band are attenuated below the general limits by 10 dB; and emissions above 10,600 MHz are attenuated below the general limits by 10 dB. There are usage restrictions and a labelling requirement.

- Indoor-only systems may operate with the –10 dB bandwidth within the band 3100 MHz to 10,600 MHz provided emissions below 960 MHz do not exceed the general limits; emissions in the 960-1610 MHz band are attenuated below the general limits by 34 dB; narrowband emissions in the GPS bands are attenuated below the general limits by 44 dB; emissions in the 1610-1990 MHz band are attenuated below the general limits by 12 dB; emissions in the 1990-3100 MHz band are attenuated below the general limits by 10 dB; and emissions above 10,600 MHz are attenuated below the general limits by 10 dB. There is a labelling requirement.

- Hand held systems may operate with the –10 bandwidth within the band 3100 MHz to 10,600 MHz provided emissions below 960 MHz do not exceed the general limits; emissions in the 960-1610 MHz band are attenuated below the general limits by 34 dB; narrowband emissions in the GPS bands are attenuated below the general limits by 44 dB; emissions in the 1610-1990 MHz band are attenuated below the general limits by 22 dB; emissions in the 1990-3100 MHz band are attenuated below the general limits by 20 dB; and emissions above 10,600 MHz are attenuated below the general limits by 20 dB.

- Vehicular radar systems may operate with the -10 dB bandwidth within the 22-29 GHz and with the center frequency and the frequency at which the maximum emission occurs both located above 24.075 GHz provided emissions below 960 MHz do not exceed the general limits; emissions in the 960-1610 MHz band are attenuated below the general limits by 34 dB; narrowband emissions in the GPS bands are attenuated below the general limits by 44 dB; emissions in the 1610-22,000 MHz band and in the band above 31 GHz are attenuated below the general limits by 20 dB; and emissions between 29 GHz and 31 GHz are attenuated below the general limits by 10 dB.

225. For all UWB devices, emission limits below 960 MHz are based on the use of a CISPR quasi-peak detector and average emissions above 960 MHz are based on the use of an RMS average detector with a 1 MHz resolution bandwidth. For systems operating above 960 MHz, there is a limit on the peak emission level contained within a 50 MHz bandwidth centered on the frequency, f_M, at which the highest radiated emission occurs. That limit is 0 dBm EIRP. A different resolution bandwidth of between 1 MHz and 50 MHz may be employed for the peak measurement provided the peak EIRP level does not exceed 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz. Only one peak

measurement, centered on f_M, is required. If the UWB transmitter connects to the AC power lines, there is a quasi-peak limit of 250 uV over the frequency range of 450 kHz to 30 MHz.[337]

F. Cumulative Impact

226. Proposal. While the Commission indicated that further testing and analysis is desirable on this issue, it stated in the *Notice* that it appeared that cumulative impact is negligible at the power levels and with the modulation types being proposed, especially when compared to the interference potential from a single land mobile transmitter. Thus, the Commission believed that only the closest transmitter placing an emission on the frequency of concern would be of importance, obviating the need for additional attenuation to compensate for cumulative effects. However, it added that the cumulative impact of several UWB devices might be different depending on their individual emission and transmission characteristics. For example, how does the cumulative impact of those UWB transmitters that emit a line spectrum compare to those that have a high level of random pulse positioning or dithering and may appear as Gaussian noise?[338] Further, what is the relationship between pulse repetition frequency and the cumulative impact of a number of UWB devices? The Commission noted that the emission limits were established based on the potential interference from a single Part 15 device and do not take into account cumulative effects that could occur if a number of devices are located closely together. Comments and test data were requested along with relevant input from the Commission's Technical Advisory Council.

227. Comments. There was no agreement among the comments. It is obvious that emissions from multiple UWB transmitters are additive to some extent. As the UWB emissions become more noise like, they tend to add directly, as would be expected with noise emissions. This was demonstrated in the University of Texas tests using multiple UWB transmitters.[339] Other commenting parties have advanced various mathematical models of UWB system configurations to demonstrate whether the major impact is caused by the closest UWB emitter or is caused by the cumulative effect of all surrounding emitters.

228. XSI argued that there is little cumulative effect from multiple UWB devices even when they are concentrated in a small area.[340] XSI added that UWB devices could not add over distances greater than about 10 meters because of poor indoor propagation.[341] XSI noted that devices located within about 10 m of each other share a common RF channel and so must reduce power, duty cycle, or both to avoid mutual interference. As stated by Aether Wire, a local network of UWB devices will generally have only one device transmitting at any time.[342] Similarly, Sprint PCS stated that many types of UWB devices will not transmit continuously, but rather will transmit burst or packets as necessary.[343] Sprint PCS added that in that case it would not be realistic to sum interference contributions from multiple UWB transmitters that normally would not all be transmitting simultaneously.

229. Motorola stated that it expected that the UWB devices closest to the victim receiver

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337 This limit could change in the future based on the *Notice of Proposed Rule Making* in ET Docket No. 98-80, *supra*.

338 Most UWB transmitters produce a line spectrum while those employing high levels of random pulse positioning can appear more as Gaussian noise. For the former devices, the emission only appears as noise depending on the settings of the measurement instrumentation.

339 *See* TDC submission of 3/9/01, *supra*.

340 XSI *ex parte* response of 7/25/01 at pg. 3-4 and 5-6.

341 XSI was promoting an indoor-only system.

342 Aether Wire comments at pg. 12.

343 Sprint PCS comments at Attachment 1, pg. 1-2.

would dominate due to typical path losses.[344] Its Monte Carlo analysis demonstrated that the vast majority of the time more than 90 percent of the interference is coming from the closest one to five UWB transmitters. Thus, Motorola concluded that even with 1000 surrounding transmitters the effect of cumulative interference was not as severe as the effect from the closest transmitters. Motorola's analysis found that a cumulative effect was more prevalent where the victim receiver was a base station with no nearby UWB transmitters. Under this condition, it took a considerably greater number of transmitters to contribute 90 percent of the interference power, using UWB emission contributions from as far away as 600 m.[345] As stated by AT&T, the important issue is how many transmitters operating simultaneously within a specified range will cause an additive power problem.[346]

230. NTIA employed a mathematical analysis using successive, equally spaced rings containing UWB emitters with their energy maximized in the direction of the victim receiver to demonstrate that high concentrations of UWB transmitters could result in cumulative interference.[347] However, XSI demonstrated that if only one UWB transmitter was placed within the inner ring used in NTIA's analysis the emission from that single UWB transmitter would dominate the signal at the victim receiver.

231. DOD provided mathematical analyses of possible cumulative interference from UWB operation to its SEEK Skyhook radar system, operating at 3.15 GHz and at 3.23 GHz.[348] The SEEK Skyhook is a surveillance radar positioned 12,000 feet above mean sea level operating with a range of 278 km at an altitude of 3660 meters. It currently is used to detect low flying aircraft for drug interdiction at Cudjoe Key, Florida and operates with a narrow 40 dBi antenna tilted at −1.5 degrees. Based on these specifications, DOD calculated the ground area illuminated by the radar antenna and the distance to the center of that range to determine how many UWB emitters could be permitted per square kilometer based on I/N levels ranging from −3 dB to −10 dB.[349] It concluded that a UWB emission level of −53 dBm covers most of the interference situations it analyzed and that mitigating factors from UWB antenna patterns, intermittent operation, building attenuation, and obstacle attenuation would permit a higher signal level.

232. ARRL stated that while more distant radiators would create less noise, this would be offset by the fact that there are more of them seen by the victim receiver.[350] It added that the large antennas used by amateur operators at UHF and higher frequencies would see a cumulative effect when overlooking urban areas. ARRL added that a single UWB emitter may dominate if the interference extended only for tens of meters, but as demonstrated by Motorola the interference could extend for hundreds of meters.[351] TDC argued that the closest UWB transmitter would produce the greatest impact as signals from more distant devices would be subsumed by the noise floor.

233. Discussion. We agree with ARRL that a single UWB emitter will dominate if the

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344 Motorola comments at pg. 10 and 20-21.

345 Motorola comments at pg. 26-27.

346 AT&T comments at pg. 6.

347 NTIA Special Publication 01-43, *supra*, at pg. 5-1 through 5-34 and B-1 through B-27.

348 Filing of U.S. Department of Defense submitted 10/1/00, Attachment 1.

349 We believe that the power levels being permitted for UWB operation would need to be considerably higher in order to transverse the hundreds of kilometers necessary to cause interference to the DOD SEEK Skyhook radar system.

350 ARRL comments at pg. 13-14.

351 ARRL reply comments at pg. 8.

interference extends for only a few tens of meters. Earlier in this Report and Order, we demonstrated that the interference impact of a single UWB device is on the order of "tens of meters" or less with the exception of a few sensitive receivers that operate at the noise floor and employ high gain antennas, such as the ARSR-4 system.[352] The ARSR-4 would not be particularly prone to cumulative interference as it views only a narrow ground segment at any given time.[353] Systems prone to receiving cumulative interference are those that employ high gain receiving antennas directed over large geographical areas. Examples are airborne systems and receivers located on orbiting satellites. Wide coverage area cellular and PCS base stations also may experience some cumulative impact although it should be considerably less than that received by airborne receivers.

234. We have implemented considerable restraints on the technical and operational standards for UWB equipment to ensure that cumulative interference will not occur. Primarily, we have limited outdoor applications to imaging, hand held and vehicle radar systems. The directional antennas employed by imaging and vehicle radar systems make it unlikely that the maximum emission components would be directed towards a victim receiver. Thus, directional antennas prevent the occurrence of multiple UWB emitters from producing equally received emission levels even if they are equally distant from the victim receiver. Also, the majority of the UWB radar devices being authorized direct their emissions into the ground or horizontally, away from airborne or satellite receivers. In addition, limiting the applications to systems that operate at ground level[354] ensures that the emissions attenuate more rapidly with distance and have a higher probability of obstructions between the UWB transmitter and the victim receiver. Most of the imaging UWB devices will operate only infrequently and will be far apart such that it is unlikely they will cause any cumulative effect. We also implemented constraints on the frequency bands in which the equipment is permitted to operate. Limiting devices to operate above certain frequency bands ensures that the maximum emissions will not occur in lower frequency bands where greater propagation may occur. Finally, we required UWB devices to operate at reduced emission levels between 960 MHz and 1990 MHz or higher, significantly reducing the range over which the UWB emissions in this band can be detected. All of these features combine to ensure that UWB systems will not result in a cumulative interference problem. While it is possible that indoor UWB devices, operating in an omnidirectional mode, could be sufficiently concentrated in a small area to cause a cumulative effect, XSI, Sprint PCS and others have already demonstrated that these devices will not operate simultaneously.[355] It is more likely that any high concentration of UWB devices operating indoors would be an interlinked system with a low overall duty cycle so as to avoid mutual interference.

G. Measurement Procedures

235. In the *Notice*, we proposed to continue to employ quasi-peak measurements for emissions below 1 GHz and average and peak measurements for emissions above 1 GHz, as under the current rules.[356] Quasi-peak measurements provide a weighted average over a specified measurement bandwidth while average measurements above 1 GHz are based on the use of a 1 MHz resolution bandwidth ("RBW"). Comments were sought regarding the specific measurement procedures that should be

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352 Interference to systems such as the ARSR-4 has been sufficiently addressed through the emission limits being adopted in this proceeding.

353 The directional signal characteristics of the UWB systems also will reduce the number of UWB devices "visible" to the ARSR-4 receiver.

354 We expect that most handheld devices would be operated indoors or at ground level.

355 As noted earlier, it will appear to outdoor receivers that indoor UWB systems are operating with directional antennas due to variable attenuation from building walls and randomly placed obstacles within the building.

356 *See* 47 C.F.R. §§ 15.35(b) and 15.209(d). There are also certain rule sections that specify the application of a total peak power limit over a wider bandwidth. *See*, for example, 47 C.F.R. §§ 15.247(b) and 15.255(e).

employed.

1. Quasi-peak and Average Measurements

236. For measuring average emissions, we proposed in the *Notice* that spectrum analyzer video averaging with a video bandwidth ("VBW") of no greater than 10 kHz or less than 10 Hz be used in conjunction with peak hold to determine the average level as a function of frequency. Alternative techniques that can be shown to give comparable or more accurate results would be considered. Comments were requested on applying the measurement procedures specified in HP Application Note 150-2. Under this note, if there was no dithering of the pulse position or pulse position modulation, the average level of the fundamental and harmonic emissions would be measured using a spectrum analyzer adjusted to produce a line spectrum with the VBW equal to or greater than the RBW. This requires that the RBW be less than, or equal to, 0.3 times the pulse repetition frequency. The level of the highest line in the emission line spectrum being measured would be the average level. If the dithering or pulse position modulation could not be turned off, the emission would be measured with the spectrum analyzer settings adjusted to obtain a true pulse spectrum. A pulse desensitization correction factor, based on the calculations provided in HP Application Note 150-2, would be added to the measurement to obtain a peak level, and the average would be calculated using the duty cycle factor in dB.

237. Comments. Quasi-peak and average emission measurements are well understood, and ANSI[357] and others have established appropriate measurement procedures. ANRO, Bosch and Zircon supported the proposed average measurement techniques.[358] There were, however, several requests for variations from our measurement procedures. NTIA requested that we apply an average limit based on an RMS average rather than a logarithmic average, such as would be obtained from a spectrum analyzer employing a low video bandwidth.[359] It stated that the average logarithm is largely insensitive to energy contained in low duty cycle, high amplitude signals. It added that no single average detector function adequately describes the interference effects of UWB signals but the RMS average better quantifies this. NTIA also wished to apply the average emission limits above 960 MHz instead of 1000 MHz.[360]

238. On the other hand, Lucent requested that the VBW employed for an average measurement be greater than 10 Hz because of the possibility of burst transmissions.[361] Lucent was concerned that a 10 Hz VBW, approximating averaging over a 100 millisecond period, would result in too low a measured value, permitting the actual radiated emission to exceed our average limits. Lucent requested that the VBW be set no lower than 10 kHz or that an undefined "correction factor" be applied when the transmitter operating time was less than the averaging time of the measurement. Metricom requested that average measurements be made using a RBW of 50 MHz, just like the peak measurements.[362] A narrower VBW would be employed to average the emission.

239. Most of the comments were directed not towards the actual measurement instrumentation

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357 American National Standards Institute (ANSI) ANSI C63.4-1992, *Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*, is specified in the Part 15 regulations as the measurement procedure applicable to Part 15 devices. *See* 47 C.F.R. § 15.31(a)(6).

358 ANRO comments at pg. 2; Bosch comments at pg. 5; Zircon comments at pg. 4.

359 *See* NTIA Report 01-383, *supra*, at pg. 6-18 through 6-25 and A-1 through A-21. *See*, also, NTIA Special Publication 01-43, *supra*, at pg. 2-1 through 2-2.

360 One of the U.S. Government frequency bands starts at 960 MHz, not at 1000 MHz.

361 Lucent comments at pg. 3. Burst transmissions are extremely short transmission intervals that have a low average emission level.

362 Metricom comments at pg. 5.

settings but to the test setup itself. With regard to GPRs, A. Peter Annan expressed concern that GPRs may not be perfectly coupled with the ground, suggesting that the GPRs be measured while suspended in the air and 20 to 40 dB be subtracted from the results.[363] Mr. Annan also requested that GPRs operating below 250 MHz be measured with a resistive load substituted for the antenna. CSSIP requested that GPRs be measured with the antennas in contact with, or in close proximity to, the ground using a suitable media of dry sand, freshwater, salty-water or concrete made from specified materials.[364] An *ex parte* filing by Sensors & Software and GSSI requested the use of a concrete slab, at least 8 inches thick, the size of the GPR transducer and installed over 12 inches of gravel, be used as the absorptive material for a GPR.[365] No metal or fiberglass reinforcing bar would be used in this base material.

240. TDC also suggested several provisions for the test set-up for UWB measurements.[366] TDC requested that we permit measurements at 1 meter due to the need for the measured emission to be at least 10 dB above the noise level of the spectrum analyzer for accuracy purposes. Bosch suggested the use of a corrugated horn antenna for measuring emissions above 1 GHz as these antennas have a fixed phase center and may be used over a wide bandwidth.[367]

241. Discussion. There is no apparent difficulty in performing measurements of quasi-peak or average emission levels. Such procedures are well documented in the current FCC test procedures and the application notes published by spectrum analyzer manufacturers. There are, however, a few areas where we need to provide clarification of the measurement procedures. A measurement procedure applicable to UWB devices is attached as Appendix F. The following discussion provides the reasons for several of the features we are including in these procedures.[368]

242. We concur with NTIA's request that logarithmic averaging not be permitted for UWB average measurements. We currently do not permit a logarithmic average to be employed for any Part 15 measurements with one exception: if the peak-to-average ratio of an emission is low and the measured emission is well below our limits, we have permitted the use of logarithmic averaging in order to facilitate measurements. While we normally perform measurements of emissions from Part 15 devices with the detector on the spectrum analyzer set in the linear mode[369], we recognize that the test data and analyses in this proceeding were performed based on RMS average emission levels. In keeping with our conservative approach to implementing UWB operation, we are adopting NTIA's suggestion to specify the average emission limits in terms of RMS average. A 1 MHz resolution bandwidth would be employed with an RMS detector and an averaging time of 1 millisecond or less. Appendix F also describes an alternative method that can be used to measure RMS average emission levels using spectrum analyzers that do not have an RMS detector. We also are implementing NTIA's request to begin RMS average emission limits, based on the use of a 1 MHz resolution bandwidth, beginning at 960 MHz.

243. We do not agree with Lucent that a minimum VBW of 10 kHz needs to be established[370] or that a "correction factor" needs to be applied to average emission measurements of short burst

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363 A. Peter Annan comments at pg. 7-8.

364 CSSIP comments at pg. 2.

365 Sensors & Software and GSSI *ex parte* filing of 10/10/01.

366 TDC comments at pg. 36-42 and reply comments at pg. 59.

367 Bosch comments at pg. 5.

368 We noted under the discussion on emission limits the need to test for narrowband emission levels in the GPS frequency bands and the test procedure that would be applied.

369 Linear averaging can be accomplished by using appropriate video averaging or by trace averaging.

370 It is not necessary to specify a video bandwidth with an RMS detector.

transmissions. Lucent has not provided any information to demonstrate why the application of a 10 Hz VBW, representing an averaging period of 100 milliseconds, to a burst UWB transmission would result in a higher interference potential. We agree that burst transmissions would have a low average measurement because of their short period of operation. However, the peak levels we are establishing would limit such transmissions. A UWB system with a high peak-to-average ratio would be peak-limited, resulting in the measured average emission level being well below our limits. We also reject the proposal by Metricom to employ a 50 MHz RBW for average measurements. Metricom did not provide any justification as to why such a large RBW is necessary for average measurements. It appears that Metricom wanted the use of a wider RBW, without a corresponding increase in permitted signal level, solely to reduce the levels of the radiated emissions. We also note that measurement equipment employing such a wide RBW is not commonly available in laboratory environments, and we are unsure about the repeatability of measurements made using such equipment.

244. In most cases, measurements will follow the procedures specified in 47 C.F.R. §15.31(a)(6). However, we believe that the measurement procedures applied to UWB devices also should address the manner in which the equipment is designed to be operated. For example, through-wall imaging systems are intended to transmit through a wall that may not dissipate much of the energy. Thus, these systems may be tested with a ½ inch section of gypsum board in front of the transmitting antenna. No attenuating material would be employed in front of medical imaging systems, vehicle radar systems, indoor systems, or hand held devices.[371] On the other hand, GPRs and wall imaging systems are designed to dissipate their transmitted energy into the ground or other structure into which they are radiating. Testing these devices over a ground plane would cause the transmitted energy to be reflected back into the air. Thus, we agree with CSSIP, Sensors & Software and GSSI that GPRs and wall imaging systems should be tested over an absorptive material. We are specifying that the transmitted emission from a GPR or a wall imaging system is to be directed towards 20 inches of dry sand. We believe that the use of dry sand will be easier to establish than a concrete/gravel test bed and would not contain the discontinuity at 8 inches as would occur with the concrete/gravel interface. This dry sand bed shall be at least the width and length of the GPR or wall imaging system being tested. Further, no ground plane shall be located under this dry sand bed. GPRs shall be suspended above this material at the height above ground at which the equipment is intended to operate. Wall imaging systems shall be suspended above this material at the separation distance at which they are intended to operate from a wall. Recognizing that the use of this absorptive material will prevent the use of a turntable, measurements must be taken at a sufficient number of radials to ensure that the measured emission levels are maximized.

245. Because of the lack of ground plane material in the test bed used for GPRs and wall imaging systems, we are establishing a test procedure than may be used for any UWB device as an option to using a ground plane. We will permit RF absorptive material, such as that found in an anechoic chamber, to be employed between the equipment under test and the measuring instrumentation. However, if this absorptive material is used 4.7 dB must be added to the obtained measurement results to simulate the effect of an additive signal reflected from the ground plane. In addition, measurements may be made at a closer distance, as requested by TDC, following the existing procedures in 47 C.F.R. § 15.31(f). However, measurements may not be made in the near field.

2. Peak Measurements

246. Proposal. In the *Notice*, we recognized that the measurement of peak power based on a 50 MHz measurement bandwidth can not be performed with normal commercial EMC test equipment. We noted that microwave receivers designed for radar interception and analysis are available with such characteristics and have costs comparable to normal EMC test equipment. Further, the IF output of a

[371] The type of material in front of these transmitters, if any, could vary. Thus, no attempt was made to categorize this material.

microwave receiver that uses a wide bandwidth. *e.g.*, 50 MHz, could be analyzed using a conventional oscilloscope in order to measure the peak level of the waveform in the time domain. Comments were sought on the feasibility of this testing technique as well as its utility as a model for the interference potential of peak UWB levels. As we are not adopting a standard for total peak power, there is no need to discuss a corresponding measurement procedure.[372] Similarly, there is no need to reiterate the discussion on antennas suitable for extreme bandwidth measurements.

247. Comments/Discussion. Several of the comments responded to the systematic problems of measuring a peak emission level over a 50 MHz bandwidth. TDC supplied a detailed measurement procedure for accomplishing this.[373] We appreciate the efforts of the commenting parties. Unfortunately, upon reflection we do not believe that peak measurements employing a 50 MHz bandwidth are practical using currently available equipment. As has become obvious from the comments, there are considerable difficulties maintaining phase accuracy over a 50 MHz bandwidth making calibration of the setup of the test bed and the measurements of the radiated emissions difficult. Further, the choice of the variable-frequency filter used to perform measurements over a 50 MHz bandwidth is extremely critical. It is unlikely that measurements over a 50 MHz bandwidth would be repeatable from one test site to another.

248. Siemens suggested measuring the peak emission level using the maximum RBW available on the instrumentation and calculating the peak emission at 50 MHz.[374] Valeo proposed a method of integrating a measurement from a spectrum analyzer over 50 MHz.[375] As stated by Fantasma, the existing rules employing a 1 MHz RBW are simple and straight forward.[376] While USGPSIC argued against the use of a spectrum analyzer, stating that spectrum analyzers sample at too low a rate to capture the peak power of UWB signals[377], we believe that a spectrum analyzer can provide a realistic view of the peak emission level as it would be viewed by a receiver employing a similar bandwidth.

249. We believe that there is a simpler method of measuring peak emission levels in a manner that also takes into account the interference potential of the equipment. In order to perform a peak measurement on a spectrum analyzer, the VBW must be at least as large as the RBW. The largest VBW on a spectrum analyzer is about 7 MHz. Thus, the widest RBW that could be employed is 3 MHz. However, there are several receivers used by the authorized radio services that employ greater bandwidths. Thus, the concern is how to ensure that peak measurements performed with a 3 MHz RBW will protect receivers that employ a wider bandwidth from harmful interference.

250. Appendix E attached to this Report and Order demonstrates the theoretical peak-to-average relationship of a pulsed emission and a dithered emission that appears like Gaussian noise as the PRF is varied. In these graphs, the average is based on measurements performed with a 1 MHz RBW. The peak measurements are based on measurements performed with a RBW of 1 MHz, 3 MHz and 50 MHz. As can be seen, the major differences between changes in RBW are not based on a 10 log relationship. Rather, they are based on a 20 log relationship.[378] We established a peak emission limit of 0 dBm as measured over a 50 MHz bandwidth. Under these conditions, reducing the RBW from 50 MHz

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372 The comments noted considerable difficulties in attempting to measure total peak output levels. *See*, for example, TDC comments at pg. 42-43.

373 TDC reply comments at Appendix C.

374 Siemens comments at pg. 1.

375 Valeo comments at pg. 12.

376 Fantasma reply comments at pg. 9.

377 USGPSIC comments at pg. 45, footnote 81.

378 The worst case comparison occurs when the PRF is less than RBW/0.45.

to 3 MHz results in an attenuation of the peak limit of 20 log (3/50) or –24.44 dBm.[379] Reducing the allowed peak limit to an EIRP of –24.44 dBm when measured with a 3 MHz RBW ensures that the emission would be no greater than 0 dBm if it was measured with a 50 MHz RBW. Peak measurements using a spectrum analyzer with a 3 MHz RBW are relatively straight-forward and can be performed using existing measurement procedures. It also is expected that these measurements should be reproducible between different measurement sites. For these reasons, we are adopting a peak measurement procedure employing a 3 MHz resolution bandwidth. This measurement must be performed centered on the frequency of emission on which appears the highest average level emission.

251. As stated earlier, our conversion from a 50 MHz resolution bandwidth to a 3 MHz resolution bandwidth is based on the worse case assumption that changes in the peak levels changes follow the square of the change in the resolution bandwidth. That is, the change in the allowable peak limit at 50 MHz to a peak limit at 3 MHz was based on 20 log (3/50) dB. We also recognized that this could penalize some UWB operations, particularly those operating with PRFs greater than around 6.7 MHz. To compensate for this, peak limits were established based on a sliding scale that is dependent on the actual resolution bandwidth employed in the measurement. The peak EIRP limit is 20 log (RBW/50) dBm when measured with a resolution bandwidth between 1 MHz and 50 MHz.[380] RBW is the resolution bandwidth in megahertz actually employed. This bandwidth must be centered on the frequency at which the highest radiated emission occurs.

252. We intend to employ at our laboratory a measurement procedure using a 3 MHz resolution bandwidth. However, we will permit responsible parties to test their UWB products using different resolution bandwidths ranging from 1 MHz to as high as 50 MHz. The use of a higher resolution bandwidth may be particularly helpful for measuring a system operating at a higher PRF. If a resolution bandwidth greater than 3 MHz is employed, the application for certification filed with the Commission must contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

3. Frequency Range of Measurement

253. Proposal. For impulse systems, the Commission proposed that the center frequency of the emission bandwidth, as determined by the –10 dB points, should be used as the reference for determining the upper frequency range over which emissions should be measured.[381] Noting that the emission spectrum will change depending on the specific measurement procedures employed, *e.g.*, the use of average versus peak measurements, comments were requested on any specific measurement procedures that should be employed to determine the center frequency. For a carrier modulated system, the Commission proposed that the carrier frequency should continue to be used as the reference for determining the upper frequency range over which emissions should be measured. However, the Commission expressed concern that a manufacturer could employ a low frequency carrier with an extremely narrow pulse or a narrow pulse impulse system could be used with a low frequency antenna, resulting in emissions extending far beyond the tenth harmonic, the normal upper range of measurement. Accordingly, comments were requested on whether a different method of determining the frequency measurement range should be employed, *e.g.*, a system based on pulse rise time and width. In addition, it was noted that the lower frequency range of measurements would continue to be determined by the lowest

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[379] If peak measurements were to be performed using a 1 MHz bandwidth, the peak limit would be decreased by 20 log (1/50) or to an EIRP of –34 dBm.

[380] This may be converted to a peak field strength level at 3 meters using E(dBuV/m) = P(dBm EIRP) + 95.2.

[381] While several references to the –20 dB emission points were made in the comments for defining UWB emissions, we believe that the –10 dB emissions points are more appropriate for determining the center frequency as it is unlikely that the –10 dB points would be below the noise floor of a spectrum analyzer.

radio frequency generated in the device. Comments were requested on whether the pulse repetition frequency, pulse dithering frequency, modulating frequency or other factors would permit the investigation of a low enough frequency range to address possible amplification of the emitted signal due to antenna resonances below the fundamental emission.

254. Comments/Discussion. There were no pertinent comments regarding the proposed frequency range over which measurements should be performed. Valeo stated that the measurement ranges are appropriate as referenced to the carrier or center frequency.[382] Our primary concern is that a sufficient frequency range be investigated to ensure that the emitted signals are no greater than the limits contained in Part 15 so that harmful interference is not caused to other users of the spectrum

255. UWB operation is unique with regard to the possible range of emissions that could be radiated from the transmitter. The generated pulse could result in a fundamental emission that is several gigahertz wide. Similarly, the side lobes also could be several gigahertz wide with the amplitude of the secondary lobe(s) only attenuated slightly below the level of the fundamental emission. It is the resonant frequency of the antenna employed with the UWB transmitter that determines the relative amplitudes of the radiated emissions.[383] The antenna can be resonant on several frequencies over a wide range both low and high. Thus, it is difficult to precisely state a frequency range of measurement.

256. We would rather proceed cautiously for these initial standards. We believe that the frequency range over which radiated emissions are investigated should include at least the fundamental emission and the secondary lobe regardless of the center frequency. This can be accomplished by requiring that the emissions be measured up to at least the center frequency added to three divided by the width of the pulse in seconds. Of course, we recognize that there is no need to require the emissions to be measured beyond 200 GHz, as could otherwise be required for extremely short pulses.[384] On the other hand, we do not wish to overburden equipment manufacturers with extensive measurement ranges that may not be necessary. Accordingly, we believe that we can compromise by establishing the following parameters. The radio spectrum produced by a UWB transmitter shall be investigated from the lowest frequency generated within the device, without going below 9 kHz, up to the frequency range shown in 47 C.F.R. § 15.33(a) or to the center frequency added to three divided by the pulse width in seconds, whichever is higher. The frequency range in 47 C.F.R. § 15.33(a) shall be based on the center frequency unless a higher frequency, *e.g.*, a carrier frequency, is generated within the UWB device. There is no requirement to measure emissions beyond 40 GHz provided the center frequency is less than 10 GHz; beyond 100 GHz if the center frequency is at or above 10 GHz and below 30 GHz; or beyond 200 GHz if the center frequency is at or above 30 GHz.[385]

H. Prohibition Against Class B, Damped Wave Emissions

257. The rules prohibit the use of Class B, damped wave emissions.[386] This prohibition stems from a similar International Telecommunication Union regulation and is a throwback to the days when

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382 Valeo comments at pg. 13.

383 Pulse shaping also could affect the characteristics and levels of the radiated emissions.

384 With the exception of radar transmitters operating between 76-77 GHz, 200 GHz is the current upper range of measurements for Part 15 transmitters. *See* 47 C.F.R. § 15.33(a).

385 At this time, we are not adopting regulations that would permit UWB systems to operate with a center frequency greater than 30 MHz. However, we see no reason not to adopt a general standard for the frequency range of measurement.

386 *See* 47 C.F.R. §§ 2.201(f) and 15.5(d).

spark gap transmitters were employed.[387] There is no longer a clear definition of a Class B, damped wave emission.[388] The Commission proposed to eliminate the prohibition against Class B, damped wave emissions indicating that this prohibition does not appear to be relevant at the power levels being proposed for UWB transmissions. These levels appear to be low enough to prevent harmful interference to other users of the spectrum. Further, unlike conventional damped wave transmissions it is likely that the receivers associated with UWB transmitters would attempt to recover as much of the transmitted bandwidth as possible for information processing purposes.

258. Comments. Few comments were filed in response to this proposal. TDC agreed with our proposal stating that the prohibition against damped wave emissions does not appear relevant to the current UWB technologies.[389] On the other hand, USGPSIC objected to removing the prohibition against employing damped wave emissions stating that there is no assurance that all future UWB applications will employ low power levels.[390] USGPSIC stated that it is prudent to retain the prohibition until a regulatory environment can be established that ensures stability of the national information infrastructure.

259. Discussion. The objection from USGPSIC has no technical basis. The regulations being adopted address the emission limits from UWB devices, ensuring that these devices will not operate at power levels that could cause harmful interference to the authorized radio services. Accordingly, our original supposition has been satisfied, and we are eliminating the prohibition against damped wave operation for UWB devices.

I. Other Matters

1. Operation of Wide Bandwidth Systems under the Existing Rules

260. Proposal. In the *Notice*, we proposed specific regulations regarding the frequency of operation and emission levels that would apply to UWB devices. We expressed concern that UWB manufacturers would wish to operate their products under a combination of both the UWB regulations and the existing Part 15 regulations in 47 C.F.R. §§ 15.217-15.255. This would result in a transmitter that has an extremely wide bandwidth attempting also to operate under standards that were developed for narrowband operation. An example would be a UWB device that operates at 5800 MHz attempting to demonstrate compliance with 47 C.F.R. § 15.245 over the frequency range 5785-5815 MHz while demonstrating compliance with the UWB emission limits outside of that frequency band. To prevent this method of cross-rule operation, the Commission proposed to amend 47 C.F.R. § 15.215(c) to state that intentional radiators operated under the provisions of 47 C.F.R. §§ 15.217-15.255 or Subpart E of the current regulations must be designed to ensure that the main lobe or the necessary bandwidth, whichever is less, is contained within the frequency bands designated in those rule section under which the equipment is operated. The requirement to contain the fundamental emission within one of the specified frequency bands would include the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmission over

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387 *See* Chapter II, Article 5, Section 8 of the Radio Regulations of the International Telecommunication Union.

388 The term "damped waves (Type B)" was last defined in Article 5, Section 1 of the 1938 version of the ITU regulations as "[w]aves composed of successive series of oscillations the amplitude of which, after obtaining a maximum, decreases gradually, the wave trains being keyed according to a telegraph code." A more modern version of the term "damped wave" is defined in the IEEE Standard Dictionary of Electrical and Electronic Terms, IEEE Std 100-1972, as "[a] wave in which, at every point, the amplitude of each sinusoidal component is a decreasing function of time."

389 TDC comments at pg. 44.

390 USGPSIC comments at pg. 47-48.

variations in temperature and supply voltage. If a frequency stability were not specified, the regulation would continue to recommend that the fundamental emission be kept within at least the central 80 percent of the band in order to minimize the possibility of out-of-band operation.

261. Comments. Interlogix expressed concern on how to compute the necessary bandwidth and measurements of the fundamental lobe.[391] It requested that the determination of whether an emission was contained within one of the frequency bands specified in 47 C.F.R. § 15.217-15.255 should be based on the 20 dB bandwidth of the emission. Bosch requested that higher emission levels be permitted for UWB devices if the emission is located in one of the ISM bands.[392] TDC requested that we not prohibit dual mode devices provided each mode of operation qualifies separately under the pertinent regulations.[393] Valeo and SARA also requested the ability for dual mode operation.[394] In addition, Delphi and SARA requested that higher UWB emissions be permitted if the emissions are located in the ISM bands.[395]

262. Discussion. We agree with Interlogix that the 20 dB bandwidth of an emission is an appropriate method of determining if an emission is operating within one of the frequency bands specified in 47 C.F.R. §§ 15.217-15.255 and are adopting this suggestion.[396] We also agree that dual mode operation is not prohibited provided each mode of operation can be distinguished and demonstrated to comply separately under the pertinent regulations.[397] However, we see no basis for permitting emissions from UWB devices to exceed the standards being adopted in this proceeding simply because the emissions happen to appear in an ISM band. There are a significant number of other radio services and devices operating within the ISM bands, some of which are allocated spectrum for this purpose. Examples include Location Monitoring Service systems in the 915 MHz band, Amateur Radio Service and land mobile systems operating in the 2450 MHz band, and police radar systems operating in the 24.125 GHz band. These are authorized radio services and are protected against harmful interference from the operation of Part 15 devices, regardless of whether they are located within ISM bands. The commenting parties have not provided information demonstrating that their products could operate without causing harmful interference to these authorized services. Even so, we are not persuaded that higher emission limits for UWB operation are prudent at this time. Once we have gained additional experience with the operation of UWB devices and their interference potential, additional changes to the rules could be considered.

2. Transition Provisions

263. In the *Notice*, we proposed that the regulations being adopted in this Report and Order become effective 60 days from its date of publication in the Federal Register. USGPS objected to our

391 Interlogix comments at pg. 4-5 and reply comments at pg. 2. We note that Interlogix redesigned its equipment in order to be certified under the provisions of 47 C.F.R. § 15.249.

392 Bosch comments at pg. 5 and reply comments at pg. 5.

393 TDC comments at pg. 44-45.

394 Valeo comments at pg. 4; SARA *ex parte* filing of 11/14/01.

395 Delphi comments at pg. 17-18; SARA *ex parte* filing of 11/14/01. The "ISM" bands refer to the frequency bands under 47 C.F.R. § 18.301, *e.g.*, the bands on which operation is permitted under 47 C.F.R. §§ 15.245-15.249.

396 Any emissions appearing outside of the specified frequency band must continue to meet the emission limits even if those limits require an attenuation of greater than 20 dB. For example, a spread spectrum system operating at 2400-2483.5 MHz under 47 C.F.R. § 15.245 must attenuate emissions in the 2483.5-2500 MHz band by significantly greater than 20 dB. We are using the 20 dB bandwidth only to determine that the emission is contained within the specified band.

397 We do not believe that a specific regulation is required for this interpretation.

proposal, stating that it is premature to permit the regulations to become effective within 60 days of publication in the Federal Register.[398] USGPSIC added that additional proposals are needed, and that these would be major rule changes requiring congressional review.

264. We recognize that this proceeding is considered to be a major action and that the effective date is delayed for 60 days under the Contract with America Advancement Act of 1996.[399] This provides Congress with sufficient time to review our decisions, if it so desires. Absent adoption of a petition for stay or a court-order stay of this proceeding, we see no justification for delaying further the effective date.

3. Existing Waivers

265. The Commission has issued four waivers to permit the manufacture of UWB devices. Three of the waivers were issued on June 25, 1999. TDC was issued a waiver for UWB systems that would be used by public safety personnel for high resolution imaging of persons and objects behind walls or under debris. Zircon was issued a waiver for UWB radar systems that would be used by the construction industry to detect objects hidden inside walls or other building materials. U.S. Radar was issued a waiver for ground penetrating radar systems. A fourth waiver was issued on August 6, 2001, to Kohler Co. to permit it to market UWB toilet ventilating devices. These waivers were scheduled to terminate upon the effective date of the Report and Order in this proceeding.

266. On August 16, 2001, Kohler filed a request to permit it to continue to market its product under the waiver until one year from the effective date of this Report and Order. Kohler, noting that the adopted rules may be different than those under which the waiver was granted, cited the time necessary to redesign its product, to test the redesigned device and to modify its tooling. We sympathize with Kohler's concerns and believe that these problems also would affect other companies marketing equipment under a waiver. Accordingly, we are extending the cut-off dates of the waivers issued to Time Domain Corp., to U.S. Radar, to Zircon, and to Kohler for a period of one year from the effective date of this Report and Order.

4. Miscellaneous Issues

267. *Further Notice of Proposed Rule Making.* A number of parties requested that the Commission issue a further notice of proposed rule making before adopting final rules.[400] They argue, generally, that the *Notice* was inadequate because it did not include the text of the proposed rules. They also claim that the Commission must update the proposals to take into account the information contained in the various test reports filed in the record. As stated by ARRL, the *Notice* included no proposed rules, listed a few generalized tentative conclusions about UWB, and was more akin to a Notice of Inquiry.[401] Contrary to these comments, Fantasma and XSI asserted that each regulatory measure was contemplated in the *Notice* and can be implemented without a further notice of proposed rule making.[402]

268. It is true that the *Notice* did not include the precise language of the rules we are adopting today. However, the Commission did provide a general picture of what it intended to do and that is

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398 USGPSIC comments at pg. 48-52.

399 *See* 5 U.S.C. §§ 801 *et seq.*

400 *See*, for example, ATA *et al* late filed comments of 3/27/01, and MSSI late filed comments of 10/9/01. MSSI rescinded its request in an *ex parte* filing of 11/12/01.

401 ARRL comments at pg. 3.

402 Fantasma late filed comments of 4/2/01; XSI late comments of 4/12/01 and *ex parte* filing of 7/25/01.

legally adequate under the Administrative Procedure Act.[403] In *California Citizens Band Association* v. *U.S.*, 375 F 2d 43, 48-49 (9th Cir. 1967), *cert. denied*, 389 U.S. 844 (1967), the court held that the Administrative Procedure Act "...does not require an agency to publish in advance every precise proposal which it may ultimately adopt as a rule. ...[A] notice of rulemaking is sufficient if it provides a description of the subjects and issues involved." Similarly, the court in *Forester* v. *Consumer Product Safety Com'n*, 559 F 2d 774, 787 (D.C. Cir. 1977) held that "Section 553(b) does not require that interested parties be provided precise notice of each aspect of the regulations eventually adopted. Rather, notice is sufficient if it affords interested parties a reasonable opportunity to participate in the rulemaking process..." Additional legal citations were provided by Fantasma in its filing of April 2, 2001, and by XSI in its filing of April 12, 2001.

269. Several hundred comments have been filed in this proceeding, including comments on the various technical reports and analyses. It is clear from this record that the commenters well understood the regulations under consideration for amendment and the scope of proposed changes under consideration. We find that there is sufficient information in the record to make initial decisions at this time that provide for the introduction of UWB technology based on standards that are extremely conservative in protecting radio services against harmful interference. We recognize, however, that as this technology develops and we gain experience with the potential interference of UWB devices, it is appropriate to reexamine these rules. Accordingly, within the next six to twelve months we intend to review the standards for UWB devices and issue a further rule making to explore more flexible technical standards and to address the operation of additional types of UWB operations and technology. In the meantime, we plan to expedite enforcement action for any UWB products found to be in violation of the rules we are adopting and will act promptly to eliminate any reported harmful interference from UWB devices.

270. *Delphi and Other Automotive Radar Systems*. Delphi requested that we include its radar system operating at 24.125 GHz under our provisions for UWB operation.[404] Delphi indicated that it operates at 17 GHz and at 24.125 GHz and uses several different modulation types, including swept frequency modulation. However, it is the 24.125 GHz system operating with a pseudo-noise direct sequence binary phase shift key waveform that Delphi requested for inclusion. This system transmits in the restricted band below 24 GHz at the limit in 47 C.F.R. § 15.209. SARA also has expressed interest in a similar technology.[405] We find that the SARA and Delphi systems, excluding the swept frequency modulated system, fall under the definition being adopted in this proceeding and that no further action is necessary.

5. Other Matters

271. *Operation in the PCS Bands*. Sprint objected to the basic concept of UWB operation, stating that the Commission does not have a legal right to convert Sprint's licenses into non-exclusive licenses and to require Sprint PCS to share its spectrum with others, much less share it for free.[406] Sprint PCS added that it spent over $3 billion for exclusive PCS licenses and that Commission authorization of new users constitutes breach of contract and an unlawful modification of licenses for which the

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403 *See* 5 U.S.C. 553.

404 *See* Delphi comments, reply comments and *ex parte* filings of 4/24/01, 6/07/01, 7/13/01, and 9/20/01.

405 SARA *ex parte* filing of 11/14/01. SARA also expressed concern regarding the residual carrier emission produced by its homodyne receiver. This issue will be addressed upon such time as the equipment is submitted for authorization under our certification procedure. However, we note that the levels of radiated emissions due to the local oscillator of a receiver operating above 960 MHz is not addressed under Part 15, other than the requirement that the emissions not cause harmful interference to other radio operations. *See* 47 C.F.R. § 15.101(b).

406 Sprint reply comments at pg. 13-14 and comments of 4/25/01 at pg. 8.

Government would be liable for damages.[407] However, no such contractual exclusivity exists. This spectrum is not, and has never been, exclusive to Sprint or to any other licensee or user. While Sprint PCS has been provided some exclusivity in operating licensed PCS systems within specified geographic areas, Part 15 transmitters currently are permitted to operate within the PCS and cellular frequency bands at considerably higher emission levels than those being adopted in this Report and Order.[408] In addition, there are countless other devices that emit radio emissions within these bands. In any event, we have not in this proceeding permitted any UWB devices to deliberately emit in the PCS bands. Much as we have done for other RF devices, we have simply established limits on out-of-band and spurious emissions from UWB devices that are designed to reduce the probability that harmful interference would be caused.

272. *Exemption of Unlicensed PCS Transmitters from the Restricted Bands.* Under the current rules, unlicensed PCS transmitters operating under Subpart D of Part 15 are not subject to the restricted band provisions in 47 C.F.R. § 15.205. The cross-reference in Subpart D to other applicable Part 15 regulations, as specified in 47 C.F.R. § 15.309, does not include Subpart C of Part 15 or any of the individual regulations contained in that subpart. Thus, 47 C.F.R. § 15.205, which is contained in Subpart C, does not apply to unlicensed PCS transmitters.[409] We are taking the opportunity provided by this Report and Order to clarify this current standard in our amendment to 47 C.F.R. § 15.205. As this amendment to the rules only clarifies an existing regulation, prior notice and comment are unnecessary.[410]

273. *U.S. Government Operation of UWB Devices.* When the Part 15 regulations were amended in 1989,[411] the Commission opened several frequency bands for unlicensed operation even though those bands were allocated for exclusive operation by the U.S. Government. The Commission took this action following an informal agreement with NTIA that similarly permitted it to operate equipment in exclusive non-government bands under the same Part 15 standards.[412] We will continue this policy, permitting the U.S. Government to operate in non-government frequency bands and in shared frequency bands under the Part 15 standards. Accordingly, as a condition of their use of these bands U.S. Government specifications for UWB devices operated by the U.S. Government agencies in non-government or in shared frequency bands must conform to the standards and operating conditions that are being adopted in this Order.[413] We believe that this will result in a greater number of UWB devices operating under the same parameters, facilitating our studies to readdress the appropriateness of the UWB standards within the next six to 12 months.

V. PROCEDURAL MATTERS

274. Paperwork Reduction Act of 1995 Analysis. This Report & Order contains modified information collection subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the modified

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407 Sprint PCS comments of 4/6/01 at pg. 2.

408 *See* 47 C.F.R. § 15.231.

409 Unlicensed PCS transmitters operate in the bands 1910-1930 MHz and 2390-2400 MHz. The exemption from the restricted bands only affects the limits for some of the unwanted emissions. The unwanted emissions are required to comply with the limits in 47 C.F.R. §§ 15.321(d) and 15.323(d), as appropriate.

410 *See* 47 U.S.C. 553(b)(B).

411 *See First Report and Order* in GEN Docket No. 87-389, 4 FCC Rcd. 3493 (1989).

412 *See Manual of Regulations and Procedures for Federal Radio Frequency Management*, U.S. Department of Commerce, National Telecommunications and Information Administration, January 2000, at Sections 7.8 and 7.9.

413 The operation in non-government bands of UWB devices that are not in compliance with the technical and administrative provisions contained in this Order is not permitted without the concurrence of the FCC.

information collection contained in this proceeding.

275. Final Regulatory Flexibility Certification. The Regulatory Flexibility Act of 1980, as amended (RFA)[414] requires that a regulatory flexibility analysis be prepared for rulemaking proceedings, unless the agency certifies that "the rule will not have a significant economic impact on a substantial number of small entities."[415] The RFA generally defines "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[416] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[417] A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[418]

276. In this First Report and Order, we are amending Part 15 of our rules to permit the marketing and operation of new products incorporating ultra-wideband ("UWB") technology. UWB devices operate by employing very narrow or short duration pulses that result in very large or wideband transmission bandwidths. UWB devices have the capability to provide for significant benefits for public safety, businesses and consumers. With appropriate technical standards, UWB devices can operate on spectrum occupied by existing radio services without causing interference, thereby permitting scarce spectrum resources to be used more efficiently.

277. We note that the Aircraft Owners and Pilots Association (AOPA) along with the National Business Aviation Association (NBAA) commented that the impact on small entities could not be estimated at this time.[419] They added that their constituency substantially consists of small entities, comprising individuals and small businesses that are aircraft owners and operators. AOPA and NBAA expressed concern that there would be a severe and lengthy impact to aeronautical operations should the UWB standards prove to be inadequate to protect aeronautical communications, navigation and surveillance functions. However, as demonstrated in our analyses of the interference studies on GPS there should be no impact to aeronautical radio operations from UWB devices operating under the technical limits and operational requirements we are adopting. Therefore, we find that our action will have no negative impact on this industry and in fact will have a positive impact. Further, as noted in the text we currently are limiting the expansion of UWB, out of an abundance of caution, until such time as we gain additional experience. Thus, we expect that our actions do not amount to a significant economic impact at this time. Accordingly, we certify that the rules being adopted in this Report and Order will not have a significant economic impact on a substantial number of small entities.

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414 The RFA, *see* § 5 U.S.C. S 601 *et. seq.*, has been amended by the Contract With America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

415 5 U.S.C. § 605(b).

416 5 U.S.C. § 601(6).

417 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in Small Business Act, 15 U.S.C. S § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

418 Small Business Act, § 15 U.S.C. S 632.

419 AOPA comments at pg. 16-17; NBAA comments at pg. 17.

278. We will send a copy of the First Report and Order, including a copy of this final certification, in a report to Congress pursuant to the Congressional Review Act.[420] In addition, the First Report and Order and this certification will be sent to the Chief Counsel for Advocacy of the Small Business Administration, and will be published in the Federal Register.[421]

VI. ORDERING CLAUSES

279. IT IS ORDERED that Part 15 of the Commission's Rules and Regulations IS AMENDED as specified in Appendix D, effective 60 days after publication in the Federal Register. This action is taken pursuant to Sections 4(i), 302, 303(e), 303(f), 303(r), 304 and 307 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 302, 303(e), 303(f), 303(r), 304 and 307.

280. IT IS FURTHER ORDERED that the waivers issued on June 25, 1999, to Time Domain Corporation, to U.S. Radar Inc., and to Zircon Corp. and the waiver issued on August 6, 2001, to Kohler Co. to permit the manufacture and marketing of their UWB devices remain in effect until one year from the effective date of this Report and Order.

281. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this *Report and Order*, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

282. For further information regarding this *Report and Order*, contact John A. Reed, Office of Engineering and Technology, (202) 418-2455, jreed@fcc.gov.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch

Marlene H. Dortch
Secretary

420 *See* 5 U.S.C. § 801(a)(1)(A)

421 *See* 5 U.S.C. § 605(b).

APPENDIX A
Commenting Parties

Parties filing comments:

1. Aeronautical Radio, Inc. & the Air Transport Association of America, Inc.
2. Aether Wire & Location, Inc.
3. Aircraft Owners and Pilots Association
4. Alzheimer's Association, Coastal Carolina Chapter
5. Alzheimer's Association, Middle Mississippi Chapter
6. The Amyotropic Lateral Sclerosis Association, Keith Worthington Chapter
7. The Amyotropic Lateral Sclerosis Association, Western Ohio Chapter
8. A. Peter Annan
9. ANRO Engineering, Inc.
10. Senator Bill Armistead, Alabama State Senate
11. Arc of Tennessee
12. ARRL, The National Association for Amateur Radio
13. Arthur D. Little, Inc.
14. The Associated General Contractors of America
15. Assistance of Independent Living, Inc.
16. Astatula Police Department (Florida)
17. AT&T Wireless Services, Inc.
18. Ball & Associates
19. Berwyn Fire Department (Illinois)
20. A/Prof. Marek Bailkowski, University of Queensland
21. Boeing Company
22. Burbank Fire Department
23. Centre for Sensor Signal and Information Processing
24. Cisco Systems, Inc.
25. Colingo, Williams, Heidelberg, Steinberger & McElhaney, P.A. (2)
26. Comprehensive Cancer Institute
27. Thomas J. Cooper
28. Congressman Bud Cramer, *et al.*
29. Daniel Group
30. Decatur Police Department, Criminal Investigation Division (Alabama)
31. Delphi Automotive Systems Corporation
32. Deutsche Bank Securities Inc.
33. William E. N. Doty
34. Dulac Fire Protection District 4-A (Louisiana)
35. DVP Incorporated
36. Endress + Hauser GmbH & Co.
37. Envoy Corporation
38. Fairlawn Fire Department (Ohio)
39. Fantasma Networks, Inc.
40. Farmington Department of Public Safety (Michigan)
41. Federal Law Enforcement Wireless Users Group
42. Federal Republic of Germany, Liaison Office for Defense Materiel USA/Canada
43. Florida Adult Day Care Association
44. Gordon E. Fornell
45. Charles Alton Forsberg
46. Fraternal Order of Police
47. Frontier Capital, LLC
48. Garmin International, Inc.

49. General Electric Company
50. Globe Fire Department (Arizona)
51. Golf-Domain
52. Groveland Police Department (Florida)
53. The Heart Center, P.C.
54. Helena Fire Department (Montana)
55. Hewlett-Packard Company
56. Houma Police Department (Louisiana)
57. Houston Police Department (Texas)
58. Representative Mike Hubbard, Alabama House of Representatives
59. Iberia Parish Council on Aging, Inc. (Louisiana)
60. Intelligent Automation, Inc.
61. Interlogix, Inc.
62. International Association of Fire Chiefs
63. International Brotherhood of Electrical Workers
64. Irmo Fire District (South Carolina)
65. Jore Corporation
66. Joseph Decosimo and Company
67. Kohler Co.
68. Krohne America Inc.
69. L-3 Communications
70. Laborers' International Union of North America
71. Leesburg Fire Department (Florida)
72. Lockheed Martin Corporation
73. Lockheed Martin Information Systems
74. Los Angeles County Sheriff's Department (California)
75. Senator Trent Lott
76. Lucent Technologies Inc.
77. M/A-COM
78. Maricopa County Emergency Management (Arizona)
79. McNeese State University
80. Metricom, Inc.
81. Metro Area Agency on Aging (W. Virginia)
82. Mobile Communications Holdings, Inc.
83. Moose Hill Enterprises, Inc.
84. Motorola, Inc.
85. Multispectral Solutions, Inc.
86. National Alliance for the Mentally Ill, Illinois
87. National Alliance for the Mentally Ill, Kansas
88. National Alliance for the Mentally Ill, South Dakota
89. National Association of Broadcasters
90. National Business Aviation Association, Inc.
91. National Safe Skies Alliance
92. National Telecommunications and Information Administration
93. National Thoroughbred Racing Association
94. National Volunteer Fire Council
95. Noro-Moseley Partners (2)
96. Nortel Networks Inc.
97. Ohio Statewide Independent Living Council
98. OnScene, Inc.
99. Plymouth Township Police Department (Michigan)
100. Professor Jon M. Peha, Carnegie Mellon University

101. Qualcomm Incorporated
102. Rainbow/PUSH Coalition
103. Redwood City Fire Department (California)
104. Richards Lighting
105. Roane County Committee on Aging, Inc. (W. Virginia)
106. Robert Bosch Gmbh
107. Rockwell Collins, Inc.
108. Saab Marine Electronics
109. San Mateo County, Office of the Sheriff (California)
110. Satellite Industry Association
111. James J. Schaffer
112. Professor Robert Scholtz, University of Southern California
113. Science Applications International Corporation
114. Senior Citizens, Inc.
115. Senior Companion Program, Van Buren Community Development and Services Board (Tennessee)
116. Senator Jeff Sessions, U.S. Senate
117. Siemens Automotive
118. Siemens Corporation
119. Sierra Monolithics, Incorporated
120. Singing River Hospital (Mississippi)
121. Sioux Falls Fire Rescue (South Dakota)
122. SiRF Technology, Inc.
123. Sirius Satellite Radio Inc.
124. Sony Corporation
125. South Dakota Coalition of Citizens with Disabilities
126. Sprint
127. Sprint Corporation
128. Staenberg Private Capital, LLC
129. Stanford University, Department of Aeronautics and Astronautics
130. STEP Inc.
131. Stephens Inc.
132. Steven T. Suess
133. Tacoma-Pierce County Chamber of Commerce (Washington)
134. Tallahassee Senior Center (Florida)
135. Congressman Billy Tauzin, *et al.*
136. Tennessee Disability Coalition
137. Terrebonne Parish Sheriff's Office (Louisiana)
138. Time Domain Corporation
139. Peter W. Torode
140. Tri-City Fire District (Arizona)
141. UCI
142. University of Mississippi, Office of the Chancellor
143. Upper East Tennessee Human Development Agency, Inc.
144. U.S. Department of Justice, Federal Bureau of Prisons
145. U.S. Department of the Navy, Office of the Assistant Secretary
146. U.S. Department of Transportation
147. U.S. GPS Industry Council
148. Valeo Electronics
149. Virginia Task Force One
150. Virtual Education, Inc.
151. Wakefield Police Department (Massachusetts)

152. Congressman Curt Weldon
153. West Virginia Department of Health and Human Resources
154. Wheeling Jesuit University, Office of Law Enforcement Technology Commercialization (West Virginia)
155. Lt. Governor Steve Windom, State of Alabama
156. Wireless Communications Association International, Inc. ("WCA")
157. XM Radio Inc.
158. XtremeSpectrum, Inc.
159. Zircon Corporation

Parties filing reply comments:

1. Aeronautical Radio, Inc. and the Air Transport Association of America, Inc.
2. Aerospace Industries Association
3. Aerospace States Association (ASA)
4. Aircraft Owners and Pilots Association (AOPA)
5. Alliance for Telecommunications Industry Solutions (ATIS)
6. Alloy LLC
7. American Association of People with Disabilities
8. American Telemedicine Association
9. American Trans Air, Inc.
10. Apple Valley Fire Protection District, California
11. ARRL, The National Association for Amateur Radio
12. AT&T Wireless Services, Inc.
13. Aviation Management Associates, Inc. (AMA)
14. Clovis Firefighters' Association
15. Colorado School of Mines, Department of Geophysics
16. Community Technology Centers' Network (CTCNet)
17. Computer & Communications Industry Association (CCIA)
18. Consortium for School Networking (CoSN)
19. Consumers Union and the Consumer Federation of America
20. Council of Chief State School Officers (D.C.)
21. Daimler Chrysler Research and Technology North America
22. Dain Rauscher Wessels
23. Delphi Automotive Systems Corporation
24. Disability Rights Education and Defense Fund, Inc.
25. Dr. William E. English
26. Fantasma Networks, Inc.
27. Fraternal Order of Police (Albuquerque, New Mexico)
28. Garmin International, Inc.
29. Dr. Jim Grigsby
30. Hays Medical Center (Kansas)
31. Iberia Medical Center (Louisiana)
32. Intel Corporation
33. Interagency GPS Executive Board (IGEB)
34. Interlogix Inc.
35. IPEG Corporation
36. iTelehealth, Inc.
37. Kohler Co.
38. Krohne, Inc.
39. Lockheed Martin Corporation (2)
40. Lucent Technologies Inc.

41. M/A-COM
42. Motorola, Inc.
43. Multispectral Solutions, Inc.
44. National Alliance for the Mentally Ill, Tennessee
45. National Association of County and City Health Officials
46. National Business Aviation Association, Inc.
47. National Catholic Educational Association
48. National Safe Skies Alliance
49. National Spectrum Managers Association
50. NAV Canada, SatNav
51. NovAtel Inc.
52. Robert Bosch Gmbh
53. Rockwell Collins, Inc.
54. Rural Wisconsin Health Cooperative
55. Rush Advanced Technology & International Health
56. Satellite Industry Association (SIA)
57. SBK Capital, LLC
58. Nancy J. Sharp
59. Don Siegelman, Governor, State of Alabama
60. SiRF Technology, Inc. & Trimble Navigation Limited
61. Sirius Satellite Radio Inc.
62. Sprint
63. Sprint PCS
64. STMicroelectronics (ST)
65. Stroud Engineering Services, Inc.
66. Time Domain Corporation (2)
67. United States Catholic Conference
68. U. S. Department of Defense
69. U. S. Department of Transportation
70. U. S. GPS Industry Council
71. University NAVSTAR Consortium
72. University of Arkansas for Medical Sciences, Rural Hospital Program
73. Verizon Telephone Companies
74. Dr. John Michael Williams
75. John A. Williamson, Sr.
76. Steve Windom, Lieutenant Governor, State of Alabama
77. Worldcom, Inc.
78. XM Radio Inc.
79. XtremeSpectrum, Inc.
80. Zircon Corporation

Appendix B
Comments in Response to NTIA's Study of Potential Interference to non-GPS Systems

Parties filing comments:

1. Aeronautical Radio, Inc. and the Air Transport Association of America. Inc. (ARINC/ATA)
2. AT&T Wireless Services, Inc. (AT&T)
3. Cingular Wireless LLC (Cingular)
4. Fantasma Networks, Inc. (Fantasma)
5. Federal Law Enforcement Wireless Users Group (FLEWUG)
6. Nickolaus E. Leggett
7. Lockheed Martin Corporation (LMC)
8. Multispectral Solutions, Inc. (MSSI)
9. National Association of Broadcasters (NAB)
10. Dr. Gary R. Olhoeft
11. Rockwell Collins, Inc.
12. Sirius Satellite Radio Inc. (Sirius)
13. Sprint Corporation
14. 3Com Corporation
15. Time Domain Corporation
16. U.S. GPS Industry Council

Parties filing reply comments:

1. AT&T Wireless Services, Inc. (AT&T)
2. Fantasma Networks, Inc. (Fantasma)
3. Multispectral Solutions, Inc. (MSSI)
4. Sirius Satellite Radio Inc. (Sirius)
5. Time Domain Corporation
6. XM Radio Inc.
7. XtremeSpectrum, Inc.

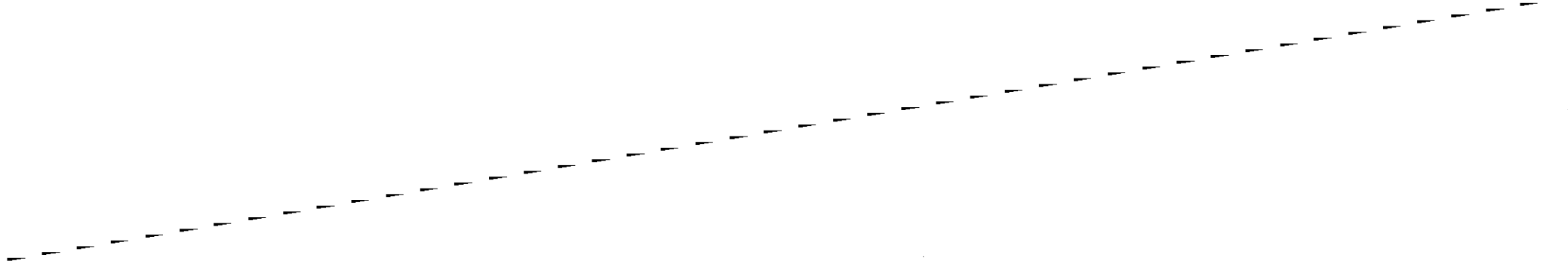
Appendix C
Comments in Response to Studies of Potential Interference to GPS Systems and to PCS

Parties filing comments:

1. Aeronautical Radio, Inc. and The Air Transport Association of America, Inc. (ARINC/ATA)
2. ANRO Engineering, Inc. (ANRO)
3. ARRL, The National Association for Amateur Radio (ARRL)
4. The Boeing Company (Boeing)
5. Centre for Sensor Signal and Information Processing (CSSIP)
6. Conexant Systems Inc.
7. Geophysical Survey Systems, Inc. (GSSI) (x2)
8. The Ground Penetrating Radar Circle of Finland
9. Johns Hopkins University Applied Physics Laboratory
10. Lockheed Martin Corporation (LMC)
11. Motorola, Inc.
12. Nokia, Inc.
13. Sirius Satellite Radio Inc. (Sirius) (x2)
14. Dr. Lee Slater
15. Sprint Corporation (Sprint)
16. Sprint Spectrum (Sprint PCS)
17. Dr. Ben K. Sternberg
18. Technos, Inc.
19. Time Domain Corporation (TDC)
20. U.S. GPS Industry Council
21. Dr. David L. Wright
22. XtremeSpectrum, Inc. (x2)

Parties filing reply comments:

1. Aeronautical Radio, Inc. and The Air Transport Association of America, Inc. (ARINC/ATA)
2. Dr. A. Peter Annan
3. ARRL, The National Association for Amateur Radio (ARRL)
4. Cingular Wireless
5. Common Ground Alliance
6. Geophysics Community
7. Interagency GPS Executive Board (IGEB)
8. Johns Hopkins University Applied Physics Laboratory
9. Mercedes-Benz USA (MBUSA)
10. Qualcomm Incorporated
11. Sirius Satellite Radio, Inc.
12. Society of Exploration Geophysicists (SEG)
13. Time Domain Corporation (TDC)
14. U.S. GPS Industry Council
15. XM RadioInc.
16. XtremeSpectrum, Inc.



Appendix D
Changes to the Regulations

Title 47 of the Code of Federal Regulations, Part 15, is amended as follows:

1. The authority citation for Part 15 continues to read as follows:

AUTHORITY: 47 U.S.C.154, 302, 303, 304, 307 and 544A.

2. Section 15.35 is amended by revising paragraph (b) to read as follows:

Section 15.35 Measurement detector function and bandwidth.

* * * * *

(b) Unless otherwise stated, on any frequency or frequencies above 1000 MHz the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules, *e.g.*, see Sections 15.255, 15.509 and 15.511. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. Measurements of AC power line conducted emissions are performed using a CISPR quasi-peak detector, even for devices for which average radiated emission measurements are specified.

* * * * *

3. Section 15.205 is amended by adding a new subparagraph (d)(6), to read as follows:

Section 15.205 Restricted bands of operation.

* * * * *

(d)(6) Transmitters operating under the provisions of Subparts D or F of this Part.

* * * * *

4. Section 15.215 is amended by revising (c) and by removing paragraph (d), to read as follows:

Section 15.215 Additional provisions to the general radiated emission limitations.

* * * * *

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in Sections 15.217 *et seq.* and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the 20 dB bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the

regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

5. Part 15 is amended by adding a new Subpart F, to read as follows:

SUBPART F – ULTRA-WIDEBAND OPERATION

Section 15.501 Scope.

This subpart sets out the regulations for unlicensed ultra-wideband transmission systems.

Section 15.503 Definitions.

(a) UWB Bandwidth. For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L. The frequency at which the highest radiated emission occurs is designated f_M.

(b) Center frequency. The center frequency, f_C, equals $(f_H + f_L)/2$.

(c) Fractional bandwidth. The fractional bandwidth equals $2(f_H - f_L)/(f_H + f_L)$.

(d) Ultra-wideband (UWB) transmitter. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

(e) Imaging system. A general category consisting of ground penetrating radar systems, medical imaging systems, wall imaging systems through-wall imaging systems and surveillance systems. As used in this subpart, imaging systems do not include systems designed to detect the location of tags or systems used to transfer voice or data information.

(f) Ground penetrating radar (GPR) system. A field disturbance sensor that is designed to operate only when in contact with, or within one meter of, the ground for the purpose of detecting or obtaining the images of buried objects or determining the physical properties within the ground. The energy from the GPR is intentionally directed down into the ground for this purpose.

(g) Medical imaging system. A field disturbance sensor that is designed to detect the location or movement of objects within the body of a person or animal.

(h) Wall imaging system. A field disturbance sensor that is designed to detect the location of objects contained within a "wall" or to determine the physical properties within the "wall." The "wall" is a concrete structure, the side of a bridge, the wall of a mine or another physical structure that is dense enough and thick enough to absorb the majority of the signal transmitted by the imaging system. This category of equipment does not include products such as "stud locators" that are designed to locate objects behind gypsum, plaster or similar walls that are not capable of absorbing the transmitted signal.

(i) Through-wall imaging system. A field disturbance sensor that is designed to detect the location or movement of persons or objects that are located on the other side of an opaque structure such as a wall or a ceiling. This category of equipment may include products such as "stud locators" that are designed to locate objects behind gypsum, plaster or similar walls that are not thick enough or dense enough to absorb the transmitted signal.

(j) Surveillance system. A field disturbance sensor used to establish a stationary RF perimeter field that is used for security purposes to detect the intrusion of persons or objects.

(k) EIRP. Equivalent isotropically radiated power, *i.e.*, the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna. The EIRP, in terms of dBm, can be converted to a field strength, in dBuV/m at 3 meters, by adding 95.2. As used in this subpart, EIRP refers to the highest signal strength measured in any direction and at any frequency from the UWB device, as tested in accordance with the procedures specified in Sections 15.31(a) and 15.523 of this chapter.

(l) Law enforcement, fire and emergency rescue organizations. As used in this subpart, this refers to those parties eligible to obtain a license from the FCC under the eligibility requirements specified in Section 90.20(a)(1) of this chapter.

(m) Hand held. As used in this subpart, a hand held device is a portable device, such as a lap top computer or a PDA, that is primarily hand held while being operated and that does not employ a fixed infrastructure.

Section 15.505 Cross reference.

(a) Except where specifically stated otherwise within this subpart, the provisions of Subparts A and B and of Sections 15.201 through 15.204 and Section 15.207 of Subpart C of this part apply to unlicensed UWB intentional radiators. The provisions of Sections 15.35(c) and 15.205 do not apply to devices operated under this subpart. The provisions of Footnote US 246 to the Table of Frequency Allocations contained in Section 2.106 of this chapter does not apply to devices operated under this subpart.

(b) The requirements of Subpart F apply only to the radio transmitter, *i.e.*, the intentional radiator, contained in the UWB device. Other aspects of the operation of a UWB device may be subject to requirements contained elsewhere in this chapter. In particular, a UWB device that contains digital circuitry not directly associated with the operation of the transmitter also is subject to the requirements for unintentional radiators in Subpart B of this chapter. Similarly, an associated receiver that operates (tunes) within the frequency range 30 MHz to 960 MHz is subject to the requirements in Subpart B of this chapter.

Section 15.507 Marketing of UWB equipment.

In some cases, the operation of UWB devices is limited to specific parties, *e.g.*, law enforcement, fire and rescue organizations operating under the auspices of a state or local government. The marketing of UWB devices must be directed solely to parties eligible to operate the equipment. The responsible party, as defined in Section 2.909 of this chapter, is responsible for ensuring that the equipment is marketed only to eligible parties. Marketing of the equipment in any other manner may be considered grounds for revocation of the grant of certification issued for the equipment.

Section 15.509 Technical requirements for low frequency imaging systems.

(a) The UWB bandwidth of an imaging system operating under the provisions of this Section must be below 960 MHz.

(b) Operation under the provisions of this section is limited to the following:

(1) GPRs and wall imaging systems operated by law enforcement, fire and emergency rescue organizations, by scientific research institutes, by commercial mining companies, or by construction companies.

(2) Through-wall imaging systems operated by law enforcement, fire or emergency rescue organizations.

(3) Parties operating this equipment must be eligible for licensing under the provisions of Part 90 of our rules.

(4) The operation of imaging systems under this section requires coordination, as detailed in Section 15.525 of this chapter.

(c) An imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In addition, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator.

(d) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209 of this chapter. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-65.3
1610-1990	-53.3
Above 1990	-51.3

(e) In addition to the radiated emission limits specified in the above table, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-75.3
1559-1610	-75.3

(f) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521 of this chapter.

(g) Imaging systems operating under the provisions of this section shall bear the following or similar statement, as adjusted for the specific provisions in paragraph (b) of this section, in a conspicuous location on the device:

> Operation of this device is restricted to law enforcement, fire and rescue officials, scientific research institutes, commercial mining companies, and construction companies. Operation by any other party is a violation of 47 U.S.C. § 301 and could subject the operator to serious legal penalties.

Section 15.511 Technical requirements for mid-frequency imaging systems.

(a) The UWB bandwidth of an imaging system operating under the provisions of this section must be contained between 1990 MHz and 10,600 MHz.

(b) Operation under the provisions of this section is limited to the following:

(1) Through-wall imaging systems operated by law enforcement, fire or emergency rescue organizations.

(2) Fixed surveillance systems operated by law enforcement, fire or emergency rescue organizations or by manufacturers licensees, petroleum licensees or power licensees as defined in Section 90.7 of this chapter.

(3) Parties operating under the provisions of this section must be eligible for licensing under the provisions of Part 90 of our rules.

(4) The operation of imaging systems under this section requires coordination, as detailed in Section 15.525 of this chapter.

(c) A through-wall imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In addition, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator.

(d) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209 of this chapter. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-53.3
1610-1990	-51.3
1990-10600	-41.3
Above 10600	-51.3

(e) In addition to the radiated emission limits specified in the above table, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-63.3
1559-1610	-63.3

(f) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521 of this chapter.

(g) Imaging systems operating under the provisions of this section shall bear the following or similar statement, as adjusted for the specific provisions in paragraph (b) of this section, in a conspicuous location on the device:

Operation of this device is restricted to law enforcement, fire and rescue officials, public utilities, and industrial entities. Operation by any other party is a violation of 47 U.S.C. § 301 and could subject the operator to serious legal penalties.

Section 15.513 Technical requirements for high frequency imaging systems.

(a) The UWB bandwidth of an imaging system operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

(b) Operation under the provisions of this section is limited to the following:

(1) GPRs and wall imaging systems operated by law enforcement, fire or emergency rescue organizations, by scientific research institutes, by commercial mining companies, or by construction companies.

(2) Medical imaging systems used at the direction of, or under the supervision of, a licensed health care practitioner.

(3) Parties operating GPRs or wall imaging systems must be eligible for licensing under the provisions of Part 90 of our rules.

(4) The operation of imaging systems under this section requires coordination, as detailed in Section 15.525 of this chapter.

(c) An imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In addition, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator.

(d) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209 of this chapter. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-65.3
1610-1990	-53.3
1990-3100	-51.3
3100-10600	-41.3
Above 10600	-51.3

(e) In addition to the radiated emission limits specified in the above table, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-75.3
1559-1610	-75.3

(f) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It

is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521 of this chapter.

(g) Imaging systems, other than medical imaging systems, operating under the provisions of this section shall bear the following or similar statement in a conspicuous location on the device:

> Operation of this device is restricted to law enforcement, fire and rescue officials, scientific research institutes, commercial mining companies, and construction companies. Operation by any other party is a violation of 47 U.S.C. § 301 and could subject the operator to serious legal penalties.

Section 15.515 Technical requirements for vehicular radar systems.

(a) Operation under the provisions of this section is limited to UWB field disturbance sensors mounted in terrestrial transportation vehicles. These devices shall operate only when the vehicle is operating, *e.g.*, the engine is running. Operation shall occur only upon specific activation, such as upon starting the vehicle, changing gears, or engaging a turn signal.

(b) The UWB bandwidth fo a vehicular radar system operating under the provisions of this section shall be contained between 22 GHz and 29 GHz. In addition, the center frequency, f_C, and the frequency at which the highest level emission occurs, f_M, must be greater than 24.075 GHz.

(c) Following proper installation, vehicular radar systems shall attenuate any emissions within the 23.6-24.0 GHz band that appear 38 degrees or greater above the horizontal plane by 25 dB below the limit specified in paragraph (d) of this chapter. For equipment authorized, manufactured or imported on or after January 1, 2005, this level of attenuation shall be 25 dB for any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane. For equipment authorized, manufactured or imported on or after January 1, 2010, this level of attenuation shall be 30 dB for any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane. For equipment authorized, manufactured or imported on or after January 1, 2014, this level of attenuation shall be 35 dB for any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane. This level of attenuation can be achieved through the antenna directivity, through a reduction in output power or any other means.

(d) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209 of this chapter. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-22,000	-61.3
22,000-29,000	-41.3
29,000-31,000	-51.3
Above 31,000	-61.3

(e) In addition to the radiated emission limits specified in the above table, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-85.3

1559-1610	-85.3

(f) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521 of this chapter.

Section 15.517 Technical requirements for indoor UWB systems.

(a) Operation under the provisions of this section is limited to UWB transmitters employed solely for indoor operation.

(1) Indoor UWB devices, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, *e.g.*, a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.

(2) The emissions from equipment operated under this section shall not be intentionally directed outside of the building in which the equipment is located, such as through a window or a doorway, to perform an outside function, such as the detection of persons about to enter a building.

(3) The use of outdoor mounted antennas, *e.g.*, antennas mounted on the outside of a building or on a telephone pole, or any other outdoors infrastructure is prohibited.

(4) Field disturbance sensors installed inside of metal or underground storage tanks are considered to operate indoors provided the emissions are directed towards the ground.

(5) A communications system shall transmit only when the intentional radiator is sending information to an associated receiver.

(b) The UWB bandwidth of a UWB system operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

(c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209 of this chapter. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-1990	-53.3
1990-3100	-51.3
3100-10600	-41.3
Above 10600	-51.3

(e) In addition to the radiated emission limits specified in the above table, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-85.3
1559-1610	-85.3

(f) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521 of this chapter.

(g) UWB systems operating under the provisions of this section shall bear the following or similar statement in a conspicuous location on the device or in the instruction manual supplied with the device:

> This equipment may only be operated indoors. Operation outdoors is in violation of 47 U.S.C. § 301 and could subject the operator to serious legal penalties.

Section 15.519 Technical requirements for hand held UWB systems.

(a) UWB devices operating under the provisions of this section must be hand held, *i.e.*, they are relatively small devices that are primarily hand held while being operated and do not employ a fixed infrastructure.

(1) A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continued to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

(2) The use of antennas mounted on outdoor structures, *e.g.*, antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.

(3) UWB devices operating under the provisions of this section may operate indoors or outdoors.

(b) The UWB bandwidth of a device operating under the provisions of this Section must be contained between 3100 MHz and 10,600 MHz.

(c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209 of this chapter. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-1900	-63.3
1900-3100	-61.3
3100-10600	-41.3
Above 10600	-61.3

(d) In addition to the radiated emission limits specified in the above table, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-85.3

1559-1610	-85.3

(e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521 of this chapter.

Section 15.521 Technical requirements applicable to all UWB devices.

(a) UWB devices may not be employed for the operation of toys. Operation onboard an aircraft, a ship or a satellite is prohibited.

(b) Manufacturers and users are reminded of the provisions of Sections 15.203 and 15.204 of this chapter.

(c) As noted in Section 15.3(k) of this chapter, digital circuitry that is used only to enable the operation of a transmitter and that does not control additional functions or capabilities is not classified as a digital device. Instead, the emissions from that digital circuitry are subject to the same limits as those applicable to the transmitter. If it can be clearly demonstrated that an emission from a UWB transmitter is due solely to emissions from digital circuitry contained within the transmitter and that the emission is not intended to be radiated from the transmitter's antenna, the limits shown in Section 15.209 of this chapter shall apply to that emission rather than the limits specified in this section.

(d) Within the tables in the above rule sections, the tighter emission limit applies at the band edges. Radiated emission levels at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector. Radiated emission levels above 960 MHz are based on RMS average measurements over a 1 MHz resolution bandwidth. The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time. If pulse gating is employed where the transmitter is quiescent for intervals that are long compared to the nominal pulse repetition interval, measurements shall be made with the pulse train gated on. Alternative measurement procedures may be considered by the Commission.

(e) The frequency at which the highest radiated emission occurs, f_M, must be contained within the UWB bandwidth.

(f) Imaging systems may be employed only for the type of information exchange described in their specific definitions contained in Section 15.503 of this chapter. The detection of tags or the transfer or data or voice information is not permitted under the standards for imaging systems.

(g) When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, f_M. If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using E(dBuV/m) = P(dBm EIRP) + 95.2. If RBW is greater than 3 MHz, the application for certification filed with the Commission must contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

(h) The highest frequency employed in Section 15.33 of this chapter to determine the frequency range over which radiated measurements are made shall be based on the center frequency, f_C, unless a higher frequency is generated within the UWB device. For measuring emission levels, the spectrum shall

be investigated from the lowest frequency generated in the UWB transmitter, without going below 9 kHz, up to the frequency range shown in Section 15.33(a) of this chapter or up to f_C + 3/(pulse width in seconds), whichever is higher. There is no requirement to measure emissions beyond 40 GHz provided f_C is less than 10 GHz; beyond 100 GHz if f_C is at or above 10 GHz and below 30 GHz; or beyond 200 GHz if f_C is at or above 30 GHz.

(i) The prohibition in Sections 2.201(f) and 15.5(d) of this chapter against Class B (damped wave) emissions does not apply to UWB devices operating under this subpart.

(j) Responsible parties are reminded of the other standards and requirements incorporated by reference in Section 15.505 of this chapter, such as a limit on emissions conducted onto the AC power lines.

Section 15.523 Measurement procedures.

Measurements shall be made in accordance with the procedures specified by the Commission.

Section 15.525 Coordination requirements.

(a) UWB imaging systems require coordination through the FCC before the equipment may be used. The operator shall comply with any constraints on equipment usage resulting from this coordination.

(b) The users of UWB imaging devices shall supply detailed operational areas to the FCC Office of Engineering and Technology who shall coordinate this information with the Federal Government through the National Telecommunications and Information Administration. The information provided by the UWB operator shall include the name, address and other pertinent contact information of the user, the desired geographical area of operation, and the FCC ID number and other nomenclature of the UWB device. This material shall be submitted to the following address:

Frequency Coordination Branch., OET
Federal Communications Commission
445 12th Street, SW
Washington, D.C. 20554

ATTN: UWB Coordination

(c) The manufacturers, or their authorized sales agents, must inform purchasers and users of their systems of the requirement to undertake detailed coordination of operational areas with the FCC prior to the equipment being operated.

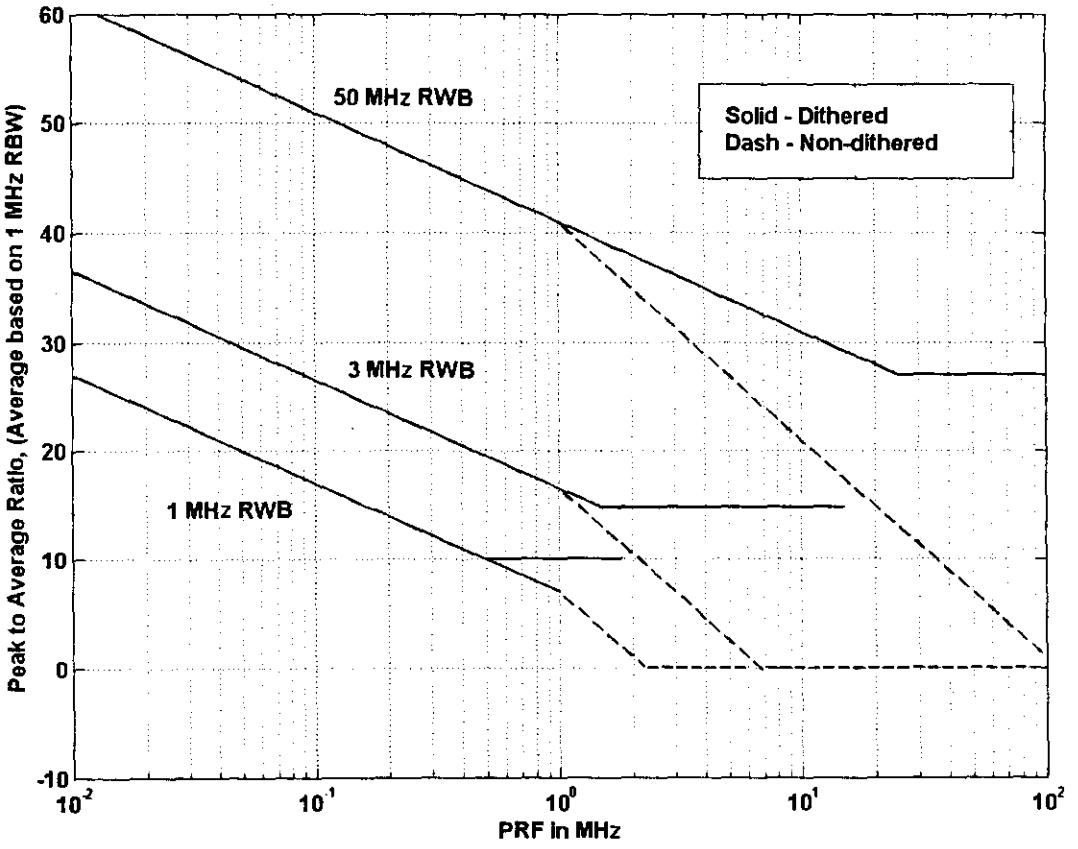
(d) Users of authorized, coordinated UWB systems may transfer them to other qualified users and to different locations upon coordination of change of ownership or location to the FCC and coordination with existing authorized operations.

(e) The NTIA/FCC coordination report shall include any needed constraints that apply to day-to-day operations. Such constraints could specify prohibited areas of operations or areas located near authorized radio stations for which additional coordination is required before operation of the UWB equipment. If additional local coordination is required, a local coordination contact will be provided.

(f) The coordination of routine UWB operations shall not take longer than 15 business days from the receipt of the coordination request by NTIA. Special temporary operations may be handled with an expedited turn-around time when circumstances warrant. The operation of UWB systems in emergency

situations involving the safety of life or property may occur without coordination provided a notification procedure, similar to that contained in Section 2.405(a)-(e) of this chapter, is followed by the UWB equipment user.

APPENDIX E
Peak in a Specific Bandwidth vs. Average in a 1 MHz Bandwidth vs. PRF



APPENDIX F
Measurement Procedures

This appendix is intended to provide general guidance for compliance measurements of UWB devices. The procedures herein are based on the Commissions current understanding of UWB technology. Modifications may be necessary as measurement experience is gained.

Except as otherwise described herein, measurements shall be made in accordance with the procedures specified in Section 15.31(a)(6) of Title 47 of the Code of Federal Regulations.

(1) Ground penetrating radars (GPRs) and wall imaging systems shall be tested under conditions that are representative of actual operating conditions. UWB devices intended for these types of application shall be compliance tested with the transducer at an operationally representative height above a twenty-inch thick bed of dry sand. The use of this medium, particularly for larger GPRs (e.g., those that are towed behind vehicles), will likely preclude the use of a turntable in the measurement procedure. For these cases, directionality gradients shall be analyzed and measurements shall be performed at a sufficient number of radials around the equipment under test to determine the radial at which the field strength values of the radiated emissions are maximized.

(2) Field strength measurements of through-wall imaging systems may be made with a ½" thick gypsum or drywall board placed between the UWB device antenna and the measurement system antenna.

(3) RMS average field strength measurements, required for all frequencies above 960 MHz, shall be made using techniques to obtain true RMS average. This can be accomplished by using a spectrum analyzer that incorporates a RMS detector. The resolution bandwidth of the analyzer shall be set to 1 MHz, the RMS detector selected, and a video integration time of 1 ms or less is to be used. If the transmitter employs pulse gating, in which the transmitter is quiescent for intervals that are long compared to the nominal pulse repetition interval, all measurements shall be made while the pulse train is gated on. Alternatively, a true RMS level can be measured using a spectrum analyzer that does not incorporate a RMS detector. This approach requires a multiple step technique beginning with a peak detection scan of the UWB spectrum with a RBW of 1 MHz and a VBW of no less than 1 MHz. The resulting trace is to be used to identify the frequency and bandwidth of the five highest peaks in the spectrum. The analyzer is then to be placed in a "zero span" mode, with a RBW of 1 MHz, a video bandwidth equal to or greater than 1 MHz, and a detector selected that does not distort or smooth the instantaneous signal levels (e.g., a "sample" detector). With these settings, a minimum of ten independent instantaneous points, representing the highest amplitude readings, are to be obtained during the time that a pulse is present, in each 1 MHz frequency bin across the bandwidth of each of the five highest peaks identified in the previous step. Note that when the PRF of the device under test is less than the measurement bandwidth of 1 MHz, a significant number of samples may be required to ensure that a minimum of 10 samples with the pulse present are obtained. The data obtained from these measurements must then be post-processed to determine true RMS average power levels. The post-processing of the data can be performed manually or with the aid of appropriate software.

(4) On any frequency or frequencies below or equal to 960 MHz, the field strength shall be measured with equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified.

(5) In the frequency bands 1164-1240 MHz and 1559-1610 MHz, average radiated field strength measurements shall be made with a resolution bandwidth of no less than 1 kHz, using techniques as described previously for determining true RMS average power levels.

(6) Peak radiated emission measurements shall be made using a spectrum analyzer with a 3 MHz resolution bandwidth and no less than a 3 MHz video bandwidth. The analyzer should be used in a maximum-hold trace mode. The peak power level expressed in a 3 MHz bandwidth and the frequency at which this level was measured shall be reported in the application for certification. A different resolution bandwidth between 1 MHz and 50 MHz may be employed with appropriate changes to the standard. If a resolution bandwidth greater than 3 MHz is employed, a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing must be submitted to the Commission. It is recommended that measurements using a resolution bandwidth greater than 3 MHz be coordinated with the Commission's laboratory staff in advance of the submission for certification.

(7) Field strength measurements may be performed without the use of a ground plane; however, a factor of 4.7 dB must be added to the measurement results thus obtained.

(8) To the extent practicable, the device under test should be measured at the distance specified in the appropriate rule section. However, in order to obtain an adequate signal-to-noise ratio in the measurement system, radiated measurements may have to be made at distances less than specified. In these cases, measurements may be performed at a distance other than what is specified, provided: measurements are not made in the near field of the measurement or device under test antenna, except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and, it can be demonstrated that the signal levels necessitated a measurement at the distance employed in order to be accurately detected by the measurement equipment.

(9) To the maximum extent possible, field strength measurements should be performed with the equipment under test positioned as it is intended to be used in actual operating conditions.

(10) Radiated field strength measurements must be made using the antenna to be employed with the UWB device under test. The measurement antenna must be sufficiently broad band to cover the frequency range of the measurements, and the use of multiple measurement antennas may be required. All measurement antennas used must be accurately calibrated and must demonstrate low phase dispersion over the frequency range of measurement. The orientation of the measurement antenna shall be varied to determine the polarization that maximizes the measured field strength.

(11) The spectrum to be investigated should include at least the fundamental emission and the secondary lobe regardless of the center frequency. In order to accomplish this, the frequency spectrum shall be investigated from the lowest frequency generated within the device, without going below 9 kHz, up to the frequency range shown in Section 15.33(a) of the FCC rules or up to an upper frequency defined by adding three divided by the pulse width in seconds to the center frequency in Hz, whichever is greater. The frequency range in Section 15.33(a) is based on the center frequency unless a higher frequency, *e.g.*, a carrier frequency, is generated within the device. There is no requirement to measure emissions beyond 40 GHz provided the center frequency is less than 10 GHz; beyond 100 GHz if the center frequency is at or above 10 GHz and below 30 GHz; or beyond 200 GHz if the center frequency is at or above 30 GHz.

SEPARATE STATEMENT OF COMMISSIONER MICHAEL J. COPPS

RE: Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems (ET Docket No. 98-153)

I believe that ultra-wideband ("UWB") technologies are destined to play a significant role across America's communications landscape. UWB devices will save firefighters' and policemen's lives, prevent automobile accidents, assist search-and-rescue crews in seeing through the rubble of disaster sites, enable broadband connections between our home electronics, and allow exciting new forms of communications in the years ahead. Indeed, the U.S. Government already uses UWB extensively to make our soldiers, airport runways, and highway bridges safer, and so much more is on the horizon.

But opinion differs greatly on the interference effect of the widespread use of UWB technologies by the public. If interference does occur, it could conceivably affect critical government and non-government spectrum users. Our national defense and several safety-of-life systems depend on bands that have the potential to be impacted by UWB devices.

Because the effects of widespread use of UWB are not yet fully known, and interference could impact critical spectrum users, I will support, albeit somewhat reluctantly, the ultra-conservative ultra-wideband step we take today. The limits we place on UWB are designed to reduce the interference risks associated with the technology to levels far, far below those placed on technologies that place energy into narrower portions of the spectrum. These limits are intentionally at the extreme end of what FCC engineers – the best spectrum engineers in the country – believe necessary. They were agreed to because of the unique and novel impact of this technology, and should not be taken as precedent for any other interference dispute – involving other Part 15 devices, government bands, or other new technologies.

I strongly support the Commission's decision to initiate a further NPRM within 6 to 12 months. My hope is that we can phase in this exciting new technology with some sense of urgency, proceeding through the conduct of expeditious step-by-step authorizations from the Commission for applications that are waiting in line. We owe it to our citizens and our businesses to determine, just as quickly as we prudently can, whether we can loosen the ultra-conservative restrictions we put in place today. So I urge all parties, especially our government colleagues, to start collecting data immediately so we can have as much data as possible, including information about their own use of UWB and how UWB effects their other uses of the spectrum, in a timely manner.

Delay, even when advisable, still has costs. If we find that our rules are too restrictive and we fail to correct them promptly, the price may be that the United States loses its leadership role in ultra-wideband. The technology could easily move overseas, where, I wager, would-be competitors are only too eager to get a step ahead of the USA. Let's be cognizant, too, of the need to proceed so as to inflict minimal harm on U.S. commercial interests. Some companies may be seriously inhibited by the limitations being announced. We should not expect that they can afford to stand patiently by while testing and approval proceeds at glacial pace. I hope that all of us, whether in government or the private sector, will approach our nation's deployment of ultra-wideband with the sense of urgency that it so clearly merits.

Finally, I want to welcome Ed Thomas to the FCC. He started with ultra-wideband – a trial by fire! I look forward to working with you. I also want to thank Julie Knapp and the whole OET team for their dedication and hard work on this item. Lots of weekends and late nights went into this Order. Thank you.

SEPARATE STATEMENT OF COMMISSIONER KEVIN J. MARTIN

RE: Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, First Report and Order (ET Docket No. 98-153).

Spectrum management decisions are always complex and challenging. In an environment where the amount of unencumbered spectrum is decreasing while demand continues to grow, it is even more critical we make interference and sharing decisions that do not waste this precious natural resource. Inevitably, we will depend more and more on sharing the spectrum currently available to avoid such waste. Sharing decisions are made particularly difficult in the context of the "fiefdom" mentality that seems to characterize players who fervently guard their spectrum "turf," regardless of whether additional use can be accommodated. Unfortunately, the result is often unrealized potential that can never be recaptured.

I am excited that ultrawideband technology, which operates at powers 10,000 times lower than PCS handsets, will allow us to take sharing to new levels, and help avoid such waste. These sophisticated applications can potentially co-exist with spectrum users in any frequency, while promising a host of exciting military, public safety, medical and consumer uses. Firefighters, police officers and emergency personnel can make use of this technology to detect and image objects that are behind walls, buried underground or even inside the human body. Automotive applications such as collision avoidance and improved airbag mechanisms will have a direct consumer safety impact. Consumers also stand to benefit from enhanced laptops, phones, video recorders, and personal digital assistants that can wirelessly send and receive streams of digital video, audio and data.

Most importantly, ultrawideband challenges the notion that use of particular frequencies or bands is necessarily mutually exclusive. In defiance of our traditional allocation paradigm that often forces us to pick "winners and losers" in the face of competing demands, this technology seems to allow more winners all around.

I am disappointed that we did not, at this time, adopt more flexible limits that may have allowed for even more widespread use of this technology. I look forward to re-examining the technical parameters established in this order once we have more data that will address the interference concerns expressed by NTIA.

I am optimistic that future technological developments will provide the Commission with more such opportunities to insist on increasingly efficient use of current spectrum. Ultimately, the amount of available spectrum and our ability to use it is perhaps limited only by technology. Today, however, we must act rationally to make the best choices within the spectrum constraints that face us now.